

## **The effectiveness of the Parent-mediated intervention for Autism Spectrum disorders in South Asia (PASS): a Randomised Controlled Trial in India and Pakistan**

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## Summary

**Background** Autism affects over 5 million children in South Asia. There are early interventions evidenced in high-income countries, but no substantive trials of adaptations within low-and middle-income countries (LMIC).

**Methods** A parallel group single blind randomised trial comparing a 12 session parent-mediated communication-focused intervention for autism (PASS) plus treatment as usual (TAU) with TAU alone delivered by non-specialist health workers from two centres (Goa, India; Rawalpindi, Pakistan). Children 2–9 years with autism were randomly assigned in a one-to-one ratio by probabilistic minimization, controlling for treatment centre; age (<6 years/≥6 years) and functional impairment (Vineland Adaptive Behaviour Scale Composite score [ $<65/\geq 65$ ]). Primary outcome was quality of parent-child interaction on the Dyadic Communication Measure for Autism (DCMA) at 8 months. Secondary outcomes were child language, social communication and functional adaptation. Analysis was by intention to treat using regression models. Trial registration; ISRCTN79675498.

**Findings** 65 children were randomized from January to July 2013 (32 PASS: Goa 15, Rawalpindi 17; 33 TAU: Goa 15, Rawalpindi 18). Eighty one percent (26/32) completed the intervention. At endpoint, adjusting for minimization factors and baseline outcome, the primary outcome showed treatment effect in favour of PASS in parental synchrony (adjusted mean difference AMD 0.25; 95% CI 0.14, 0.36) and child communication initiation with parent (AMD 0.15; 95% CI 0.04, 0.26) but reduced time in mutual shared attention (AMD -0.16; 95% CI -0.26, -0.05). Secondary outcomes showed no difference between control and intervention arms.

**Interpretation** We show the feasibility for LMIC of adapting and ‘task-shifting’ an intervention evidenced in a high-income context. PASS achieved excellent participant adherence. The trial replicates positive primary outcome treatment effects found in the original UK trial, with one negative effect not found previously. Larger scale testing and implementation of the programme is warranted.

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## Introduction

Autism Spectrum Disorder (ASD) is a neuro-developmental disability associated with impairments in social reciprocity, communication and behavior with an estimated global prevalence of between 0.5 to 1%.<sup>1</sup> ASD has a severe impact on children's social development into adulthood<sup>2</sup> with profound economic consequences (for instance >£31bn annually in UK in childhood,<sup>3</sup> higher than asthma, diabetes or intellectual disability). It is therefore a priority for the global mental health agenda.<sup>4,5</sup> ASD is a priority condition in the WHO mental health Gap Action Programme (mhGAP).<sup>6</sup>

The majority of the children with ASD live in low-income settings and have no access to treatment. South Asia is home to the largest number of children in the world, with a recent national epidemiological estimate in India of approximately five million children with ASD between 2-9 years in India.<sup>7</sup> The two key barriers to treatment access are: a) lack of evidence base for interventions that have been adapted and evaluated for feasibility in such settings and; b) lack of specialist personnel to deliver them to the vast populations outside the reach of specialist centres.<sup>8</sup> The 'treatment gap' for community interventions in the region is nearly 100% and research to address barriers to care for child mental disorders is described as one of the top five 'Grand Challenges' in global mental health.<sup>5</sup> A major innovation to reduce the treatment gap for other mental disorders is the adaptation of interventions tested in high income countries to local needs and to be feasible for 'task-shifting' for delivery by non-specialist health workers.<sup>9</sup>

In high-income countries, intervention research in ASD has recently accelerated, with studies across a range of interventions synthesized in recent NICE guidance,<sup>10</sup> Cochrane<sup>11</sup> and other reviews.<sup>12</sup> In the 2013 NICE guidance, *social communication interventions* are the only interventions recommended for consideration for treatment of core symptoms in children. In high-income countries, these social communication interventions have been tested in a number of randomised trials in the preschool period,<sup>13-15</sup> in the early school years,<sup>16</sup> and recently in the infancy prodrome.<sup>17</sup> All these intervention studies show intervention effects to improve immediate parent-child social interaction. Few studies have shown downstream effects on development of functioning or autism symptoms; one study finding an effect on language<sup>13</sup> was not replicated. Two studies from our group have shown evidence of attenuated effect on autism symptoms but with confidence intervals including the null.<sup>14,17</sup>

In low and medium income countries (LMIC) there has been very little intervention testing. Systematic reviews to June 2013<sup>11, 18, 19</sup> identify just three small studies (n=<34) of psychosocial intervention for ASD symptoms delivered by non-specialists in LMIC.<sup>20-22</sup> An updated search from to January 2015 using the same criteria identified no additional subsequent studies. Two studies from China tested brief parent-training programmes while the third study tested a 3month 'DIR/floortime' intervention against usual care tested in Thailand. In this global health context, our current study set out make a systematic cultural adaptation of a treatment for childhood autism evidenced in HIC and to test its effectiveness in South Asian settings.

The Preschool Autism Communication Trial (PACT) therapy was chosen for implementation in the current study, as a social communication intervention which was tested in the largest RCT yet undertaken in the autism field,<sup>14</sup> showing treatment effect in a number of key aspects of early dyadic communication between parent and child; including a substantial effect in improving parental synchronous responses to the child, associated in developmental research with enhanced child social and communication outcomes in both normative and autism samples.<sup>23</sup> It is also a parent-mediated treatment, which was felt likely to be appropriate to the LMIC context. These features of PACT gave confidence that the approach would be translatable, feasible and effective across socio-cultural contexts. Formative research was carried out between May 2012 and March 2013 to adapt PACT in two low and middle-income South Asian countries, India and Pakistan. A key aim was the cultural adaptation of the intervention to be compatible with local beliefs and parenting practices and procedures to be feasible for delivery by non-specialist workers.<sup>24</sup> The resulting adaptation was called the *Parent mediated intervention for Autism Spectrum Disorder in South Asia (PASS)*. This adapted intervention was based on the identical theoretical construct as PACT, utilizing a naturalistic approach to scaffolding and developing communication skills in the child with ASD. Key differences included: i) a flexibility to deliver the intervention to family members besides the parents so as to respond to the cultural context; ii) some simplification of the language and preparation of scripts for non-specialist delivery; iii) more structured guidance on delivery of strategies; iv) a shortened intervention focusing on the initial 6 months intensive phase of treatment – a period that had delivered maximum therapeutic gains in the PACT trial<sup>14</sup> and was likely to be practical for families in Asia. The aims of the RCT of PASS reported here were to evaluate: a) the feasibility and acceptability of the implementation of the PASS intervention in the selected settings in South Asia; b) the success

of the “task-shifting” approach in delivering fidelity to the intervention model; and, c) the effectiveness of the adapted model in replicating positive treatment effects on dyadic communication found in the UK PACT intervention.

## **Methods**

**Study design** A single blind two arm two-site randomized controlled trial. The trial was coordinated from two research institutions with expertise in implementing mental health trials located in Goa, India and Rawalpindi, Pakistan.

**Participants** Children aged 2 to 9 years of age identified through attendance at specialist centres or following screening within community education and health services using an adapted version of M-CHAT ([www.m-chat.org](http://www.m-chat.org)). All participants met criteria for autism on the INCLIN Diagnostic Tool for Autism Spectrum Disorder (INDT-ASD)<sup>25</sup> administered by the research team. The selected age range was broader than the UK PACT Trial because autism is typically diagnosed later in South Asia than in the UK (current mean age of diagnosis in South Asia ranging from nearly five to eight years.<sup>26</sup> We excluded children with: a twin with autism; a non-verbal age equivalent of 12 months or younger on the Vineland Adaptive Behaviour Scales (VABS); epilepsy with seizures in the previous six months; severe hearing or visual impairment in a parent or the child; or a parent with a severe psychiatric disorder requiring treatment.

**Randomisation, masking and minimisation of bias** After informed consent was obtained and baseline assessments completed, children were allocated a sequential study identification number and randomised by an independent statistician at the Manchester Academic Health Sciences (MAHSC) Clinical Trials Unit, who informed the clinical sites. Allocation was by probabilistic minimization, controlling for treatment centre (Goa/Rawalpindi); age (<6 years/≥6 years) and functional impairment (VABS Adaptive Behaviour Composite score <65/≥65). Assessors and supervising research staff were blind to treatment allocation; however, treatment allocation could not be masked from families and therapists.

The children were evaluated by trained assessors masked to the allocation status of the children. Strict separation was kept between assessment and clinical data; assessors and therapists were located and supervised separately at both sites. To avoid the effects of familiarity, materials and location for child assessment were different from those for

intervention. Assessors made baseline and endpoint assessments from anonymised videotapes, unaware of the case details, assessment point and treatment status. Because many participants would be unfamiliar with video recording, two videotapes were also made in the treatment as usual group to control for any biasing due to the exposure to videotaping itself.

## **Interventions**

***Experimental intervention*** Formative research (including qualitative parental interviews, stakeholder focus groups, case studies (or practice cases) by senior site staff and regional expert adaptation workshops) informed the adaptation process of PACT into use in South Asia and addressed potential barriers to scale-up. This adapted version of PACT was called ‘Parent-mediated intervention for Autism Spectrum disorders (ASD) in South Asia’ (PASS).<sup>24</sup> Feasibility and case series information conducted during the formative phase suggested that this adapted PACT intervention was feasible and appropriate for delivery with children up to 9 years, particularly with the more severely affected children identified in the south Asian context. As in the original PACT intervention, PASS targeted social interactive and communication impairments in autism. The rationale was that children with ASD would respond with enhanced communicative and social development to a style of parent communication adapted to their impairments. The intervention consisted of one-to-one clinic or home sessions between health worker and parent with the child present. The aim of the intervention was, first, to increase parental sensitivity and responsiveness to child communication and reduce over-directive parental responses by working with the parent and using video-feedback methods to address parent-child interaction. Second, further incremental development of the child’s communication was helped by promotion of a range of strategies such as action routines, familiar repetitive language, and pauses. The PASS intervention was thus staged and specifically manualised to reflect the developmental progression of early social communication skills

([http://hdrfoundation.org/docs/training/PASS\\_Manual\\_web-2015.pdf](http://hdrfoundation.org/docs/training/PASS_Manual_web-2015.pdf)).

Following manual adaptation, a training and supervision cascade model supported non-specialist health workers in the therapy implementation. Local autism specialists (AM, GD, VV) were initially trained in the model by the UK team (CA, CT, JG), who continued online support as necessary during the trial. The local specialists then trained and supervised the implementation therapists. In keeping with the task-shifting model, these therapists had college level education but no prior experience of delivering mental health care. The health

workers underwent a ten day training including classroom instructions, role playing and observations in resource rooms, followed by initial supervised practice-based learning on non-trial cases. The health workers had to achieve a pre-specified level of manual fidelity in order to proceed to work in the trial phase; they were supervised during the trial within local sites by the site specialists. All trial therapy sessions were video-recorded. One-on-one supervision was carried out at the two sites till the non-specialist health workers achieved a predetermined level of measured competence on a standardised assessment. Therapist fidelity to the model during the trial was evaluated by therapy experts from Manchester (CT, CA) who rated videos of 36/360 (10%) treatment sessions, randomly selected across health workers and PASS stages of PASS and used the same fidelity coding procedure as the UK PACT trial.<sup>14</sup>

The intervention was delivered in the participating parents' language of choice (In Pakistan, Urdu; in Goa, English in 5 cases, Konkani in 6, Marathi in 1, Marathi and Konkani mixed in 1 and English and Konkani mixed in 1). Families attended fortnightly 1 hour sessions for 6 months. An initial visit explored parental beliefs and other factors that might affect therapy or influence engagement with the programme. At each session a videotape of parent-child was made and watched and discussed in detail with the parents in terms of progress since the last session, fidelity to treatment goals and planning next steps. Parents undertook to spend 30 minutes daily between clinic sessions practising predefined strategies at home and were encouraged to keep a daily record of achievement. The pace of work was individualised to the parent and family's specific needs and progress and interim goals were reached before moving to the next stage.

***Treatment as Usual*** Families in both groups of the trial continued with treatment as usual as provided by their local facilities. In the experimental group, the PASS intervention was delivered completely separately, and in addition, to treatment as usual. Recognizing that caregivers' seek advice and care from a variety of health, education and traditional services,<sup>31</sup> we used the Client Services Receipt Inventory (CSRI) to measure the type of service and total hours of utilization across both arms in the six months prior to end point assessments. The questionnaire has been used both in India and Pakistan.<sup>32</sup>

***Sample Size*** The UK PACT Trial demonstrated a treatment effect on the primary parent-child interaction outcome (an effect size of 1.37 for parental synchrony and 0.5 for child

communication initiation at 6 months).<sup>7</sup> Based on this, a sample size of 60 (30 intervention, 30 non-intervention) was sufficient to allow 90% power to detect an effect size of 0.85 on dyadic interaction using a two-sample t-test with a 0.05 two-sided significance level, 80% power to detect an effect size of 0.75, and 70% power to detect an effect size of 0.65. We allowed for 10% attrition. The trial completed recruitment with n=65 (32 intervention, 33 non-intervention).

## **Outcomes**

The outcome assessments occurred 8 months after baseline assessment. All outcome measures were translated and culturally adapted using standard methodology<sup>28</sup> in a process that is described in detail elsewhere.<sup>24</sup>

**Primary outcome** Quality of parent-child interaction on the Dyadic Communication Measure for Autism (DCMA).<sup>14</sup> A videotaped session during naturalistic play in a standard research (non-treatment) setting was undertaken, consisting of 8 minutes coded interaction between parent and child following a 4 minute warm-up phase, using a standard set of age appropriate toys adapted for the culture (for instance every day stainless steel kitchen utensils which could be used as stacking toys).<sup>24</sup> The researcher coding was masked to group status, assessment point, and prior hypothesis, on three pre-specified variables coded independently of each other: i) the proportion of parental communications with the child that were ‘synchronous’ (utterances that acknowledge, confirm or reinforce the child’s focus, play, actions, thoughts or intentions); ii) the proportion of child communications with the parent that were initiations (as opposed to responses to parent); iii) the proportion of time spent in ‘mutual shared attention’ (ie. episodes in which each person shares the thoughts, feelings, experiences, objects or the attention focus of the other person). Maternal synchrony and child initiations, measured as event counts, can occur during or outside periods of mutual shared attention, a duration measure – thus are distinct in the coding scheme. DCMA coding was conducted by two assessors per site following training to full reliability with UK trainers (KL, CT) in a similar cascade model to the therapy. A random sample of 14 session clips (20%) was double coded in each site and checked by the UK originators (KL). Inter-rater reliability showed intra-class correlations of 0.9/0.92 (India/ Pakistan; parental synchrony), 0.58/0.84 (child initiations; with the result for India affected by a single case outlier; when this was removed ICC increased to 0.90) and 0.98/0.98 (mutual shared attention).



**Secondary outcomes** Child adaptation and language on the Vineland Adaptive Behaviour Scales, a standard measure of child adaptive functioning which has been used across cultures; the MacArthur Communicative Development Inventory (MCDI, infant form raw scores; and the Communication and Symbolic Behavior Scales Developmental Profile (CSBS-DP, caregiver questionnaire social composite raw scores). Each of these measures was translated and back-translated with publishers' permission and some of the items slightly modified according to local cultural meaning.<sup>24</sup>

**Procedures** For training and supervision in intervention and research assessments we used a cascaded procedure (described above and in detail elsewhere).<sup>24</sup> The UK team trained and supervised local specialists who then trained and supervised the local staff. At each site there were separate local experts for research and intervention, who trained and supervised the local assessors and health workers respectively.

### **Statistical analysis**

Analysis was undertaken according to a pre-specified analysis plan at 8 month endpoint and follows the CONSORT guidelines. The feasibility and acceptability of the implementation of the PASS intervention was shown using summary statistics. Analysis of treatment effects was on an intention-to-treat basis, including subjects in the groups to which they were randomised regardless of treatment received. The analysis for the primary outcome of a change in parent-child social communication was analysed using linear regression (analysis of covariance), co-varying for the baseline measurement of the outcome, treatment assignment, and the minimisation variables of treating centre, age (below 6 years/ 6 years and above) and functional impairment (VABS ABC score: below 65/65 and above) as fixed effects. Standard regression diagnostics were applied.

Secondary outcomes were analysed using the same approach as the primary outcome. The models allowed for analysis of all available data without imputation, under the assumption that data were missing at random, conditional on the covariates. All models were bootstrapped with 250 replications. We report estimated treatment effects, with their bootstrapped standard errors, and 95% confidence intervals. The statistician was blind to treatment allocations during the analysis.

## Ethics

The study was approved by the University of Liverpool Research Ethics Committee, local ethical committees at Goa (Sangath) and Rawalpindi (the Human Development Research Foundation) as well as by the Indian Council of Medical Research, India. In all participant families at least one parent provided written consent. The study was registered as an International Standard Randomised Controlled Trial, number ISRCTN79675498.

## Results

***Participant flow and implementation*** Participants were recruited between January 2013 and July 2013 (Rawalpindi) and March 2013 and July 2013 (Goa). Assessment at the 8-month endpoint was completed between September 2013 and March 2014. Figure 1 shows the trial profile and flow through the study. Six participants from sixty-five randomized (9.2%) were lost to follow-up, an attrition less than allowed for in the design.

*Figure 1 about here*

***Baseline data*** Table 1 shows the sample characteristics, and demonstrates the treatment groups were well matched at baseline for demographic and clinical variables.

*Table 1 about here*

***Intervention delivery*** The intervention showed high participant adherence with 26/32 (81%) overall completing the 12 session intervention. The non-specialist therapists achieved high therapist fidelity, with 89% of 36 randomly selected sessions across the intervention meeting the preset fidelity criteria on independent coding (the fidelity rating method is published<sup>14</sup> and further details are available from the authors).

Analysis of TAU during the treatment period showed some inevitable between-country differences in background provision, but that importantly for the internal validity of the trial, within each country, the type and provision of treatment provided was balanced across arms of the trial. Thus, *in Rawalpindi* services accessed outside of PASS were similar across the two trial groups. Of the families assigned to PASS, 6 children (35%; median 17.5hours/week) attended a specialist school and 6 children (35%; median 17.5 hours/week) a

mainstream school; in the TAU group, 7 children (39%; median 20 hours/ week) attended specialist schools and 5 attended mainstream schools (28%; median 25 hours/ week). *In Goa* treatment as usual services were also well balanced across the two trial groups. A majority of children in both groups in Goa attended specialist or resourced educational provision: 12 in the PASS group (80%) and 14 in the TAU group (93%), with the remainder accessing mainstream schools. In Goa, some families attended speech and language therapy outside the school setting which was similar across both trial arms: 7 children in the PASS group (47%; median 0.5 hours in treatment/week) and 7 in TAU (47%; median 0.5 hours in treatment/week). Occupational or physiotherapy was accessed by 1 (7%) child in the PASS arm and 3 (20%) in the non-PASS arm. At both sites, specialist and mainstream schools offer largely respite care with some remedial education, with no notable specific intervention. Other than occasional one-off consultations from general practitioners or traditional practitioners, no other intensive interventions such as ABA were utilized during this period at either site.

***Effectiveness of PASS*** Table 2 summarizes results for the primary outcome of parent child interaction. On parental synchronous interaction, there was a significant positive treatment effect in favour of the PASS treatment; with adjusted mean difference (AMD) of 0.25 (95% CI: 0.14 to 0.36, effect size=1.61). There was also a positive treatment effect on Child Communication Initiations with parent; AMD 0.15 (95% CI: 0.04 to 0.26, effect size=0.99). On the third interaction outcome of shared attention there was evidence of a negative effect of treatment; AMD -0.16 (95% CI: -0.26, -0.05, effect size=-0.70). In all analysis, there were no significant effects of the minimization variables on outcome.

Table 3 shows that the secondary outcomes did not show any significant differences between the control and intervention arms.

## **Discussion**

This randomised controlled trial is the first substantive intervention evaluation for ASD undertaken in LMIC. We utilized an intervention model already evidence tested and implemented in HIC, adapted this into the local context for task-shifting using standard

methods<sup>29</sup> and used a task-shifting approach to delivery supported by cascaded training and supervision. The randomized trial showed good internal validity, with attrition to follow-up for instance less than allowed for in the design. The study adds substantially to reports from previous small studies using parent-education or parent-mediated communication-based strategies.<sup>20-22</sup> We have showed that a parent-mediated intervention for early autism delivered by non-specialists in South Asia is both feasible and effective in LMIC.

The task shifting approach to implementation in LMIC has been widely advocated as a strategy across global health and, more specifically, for global mental health.<sup>30</sup> The findings from this trial suggest that this is both a feasible and successful strategy that could provide a basis for future scaling up of this and similar interventions within child neurodevelopmental disorder. Non-specialist health workers across two countries were able to train to manual fidelity in a technical psychosocial intervention for autism, and more importantly sustain this fidelity throughout the intervention trial. Family adherence to the intervention was also high. The key aspects of this success are the establishing of a clear supervisory cascade from specialist trainers in the HIC down to the non specialists, with support until the local teams achieved competency; as well as the local senior specialists supporting the building and maintenance of competencies of non-specialists through objective measures.

Two out of the three primary outcome variables measured in the parent-child interaction (parent synchrony and child initiations) were substantially improved by the PASS intervention, replicating the UK PACT trial. These are the two key outcome variables from PACT since mediation analysis in that trial<sup>27</sup> showed that it was the treatment change in synchrony that mediated increased child communication initiations and the change in initiations that mediated change in symptom severity. The effect sizes found on both these variables was in fact *greater* in PASS than in PACT (for parental synchrony ES 1.61 in PASS, 1.22 in PACT; for child communication ES 0.99 in PASS, 0.41). In conjunction with the achievement of high therapist fidelity this supports the practicality of implementing a parent-mediated intervention developed in a UK context into LMIC. The intervention was based on a developmental science of autism that has itself largely been generated within HIC; our finding of similar treatment effects on dyadic interaction in this trial suggests some universality in the relevance of these same development processes in autism within the very different cultural context of South Asia.

There are also findings that differ from the UK trials. The third interaction variable (mutual

shared attention, MSA) showed an opposite treatment effect in PASS compared to PACT. This was due to opposite directions of change within the TAU arms of each trial (in PACT MSA strongly decreasing during the trial, in PASS MSA slightly increased); whereas in the intervention arms in both trials MSA remained the same or slightly decreased. Further study is needed to see if results may relate to differences in samples, parenting style, or TAU across continents. Cultural issues may play a part; MSA change in the South Asia TAU arm is the only interaction finding that differs in direction between the two cultures. However, MSA generally shows inverse direction of change to synchrony and communication in *both* arms of *both* trials, and no mediation effect on outcome in PACT;<sup>27</sup> it is therefore a less salient outcome measurement and the meaning of the effects less clear. Similarly, there was a lack of intervention effect findings on parent-report measures in this South Asia trial, which does not replicate the findings from the UK trial, on which they showed a substantial treatment effect in favour of PACT. It is possible that the study was under-powered to detect these effects, but the findings would also benefit from further investigation in relation to the sensitivity of the measures we used (derived from HIC practice) within this cultural context.

***Strengths and limitations*** In addition to the adaptation, supervision design and internal validity of the trial, a key strength of this study is that it was conducted in real-life settings, and the intervention was delivered by workers emulating the most widely (and in many cases, the only) available human resource for health in such settings - community health workers with no specialist experience. The mhGAP intervention guidelines recommend parent-mediated interventions as the first-line management of such conditions<sup>6</sup> but recognize the gap in guidelines about how workers are trained and supervised to deliver such interventions. This is the first study of its kind to demonstrate the effectiveness of such an ASD intervention in low-income countries and thus has real potential for addressing the large treatment gap in other similar settings. A limitation for inferring success at scale-up may be the absence of recruits in this study from remote rural areas; and the fact that the intervention work was directed and supervised from academic centres with a highly motivated team; we do not therefore suggest that it will be without challenge to achieve such levels of adherence and outcome in general implementation at scale. However the results of this trial demonstrate the feasibility and effectiveness a task shifting approach, and are consistent with what our groups and others have found in the context of other task shifting interventions in other mental illness.<sup>9, 30</sup> Further research therefore to explore implementation at scale of such interventions is warranted.

## **Acknowledgements**

**Author roles:** AR, JG initiated the study. AR, JG, GD, VP, KL, CA, CT designed the study. From the UK, JG led the research coordination, KL led the research training, CA, CT led the intervention training. In south Asia, GD, UH, VV led the adaptation of the intervention and training of non-specialist interveners. Intervenors were supervised directly during the trial by AM, GD, VV with supervisory support from CA and CT. In south Asia VV, UH, PC, AR, VP supervised the local research teams, with supervisory support from KL and JG. RE conducted the data analysis. All authors were involved in interpretation. JG and AR led the writing of the paper with review from all authors. JG and RE had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. VP and JG are joint last authors and share equal responsibility with AR. The corresponding author, Jonathan Green, had full access to all of the data in the study and had final responsibility for the decision to submit for publication.

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### ***Declaration of interests***

The authors declare no declaration of interest.

### ***Panel***

**Evidence before this study** The treatment gap for Autism Spectrum Disorder (ASD) approaches 100% in low-income settings (LIC). Effective parent-mediated interventions for ASD have been developed in high-income settings (HIC) but there is a lack of research to adapt and evaluate such interventions in LIC. We conducted an electronic database search of PsycINFO, Scopus, MEDLINE, CINAHL, Cochrane Central Register for Controlled Trials with the terms including “autism spectrum disorder”, “pervasive developmental disorder”, “developing countries”, “low income countries”, “low and middle income countries”, “parent mediated” “nonspecialist delivered” “teacher delivered”, “aide delivered”. We limited our search to randomized controlled trials and systematic reviews of literature published in English language only. From this search and relevant systematic reviews of the literature up to June 2013<sup>11, 18, 19</sup> we identified just 3 small randomised controlled trials (RCTs) of psychosocial interventions for Autistic Spectrum Disorder delivered by non-specialists in LMIC (all with n<34): two parent-education programmes in China and one parent-mediated child intervention in Thailand. An updated search from June 2013 to January 2015 using the same criteria and limited to LMIC and ASD, identified no further studies.

**Added value of this study** This is the first substantive RCT of an evidence-based intervention delivered by non-specialists in two South Asian low-income settings. We adapted an intervention (PACT), evidenced in UK trials, for delivery by non-specialist workers in LMIC and tested it in a randomized trial in two south Asian countries. The intervention was successfully delivered to fidelity by the non-specialists and produced significant improvements in parent-child communication in two out of the three primary outcomes, replicating the findings from HIC. The findings suggest a commonality of developmental processes across these cultures, and strengthens the case for testing similar interventions across settings after careful adaptation to the local context.

### **Implications of all the available evidence**

Non-specialist delivered interventions for ASD should be considered feasible, acceptable and potentially effective in low-resource settings. Scale-up studies are indicated.



Fig 1: Recruitment and flow of participants through the trial

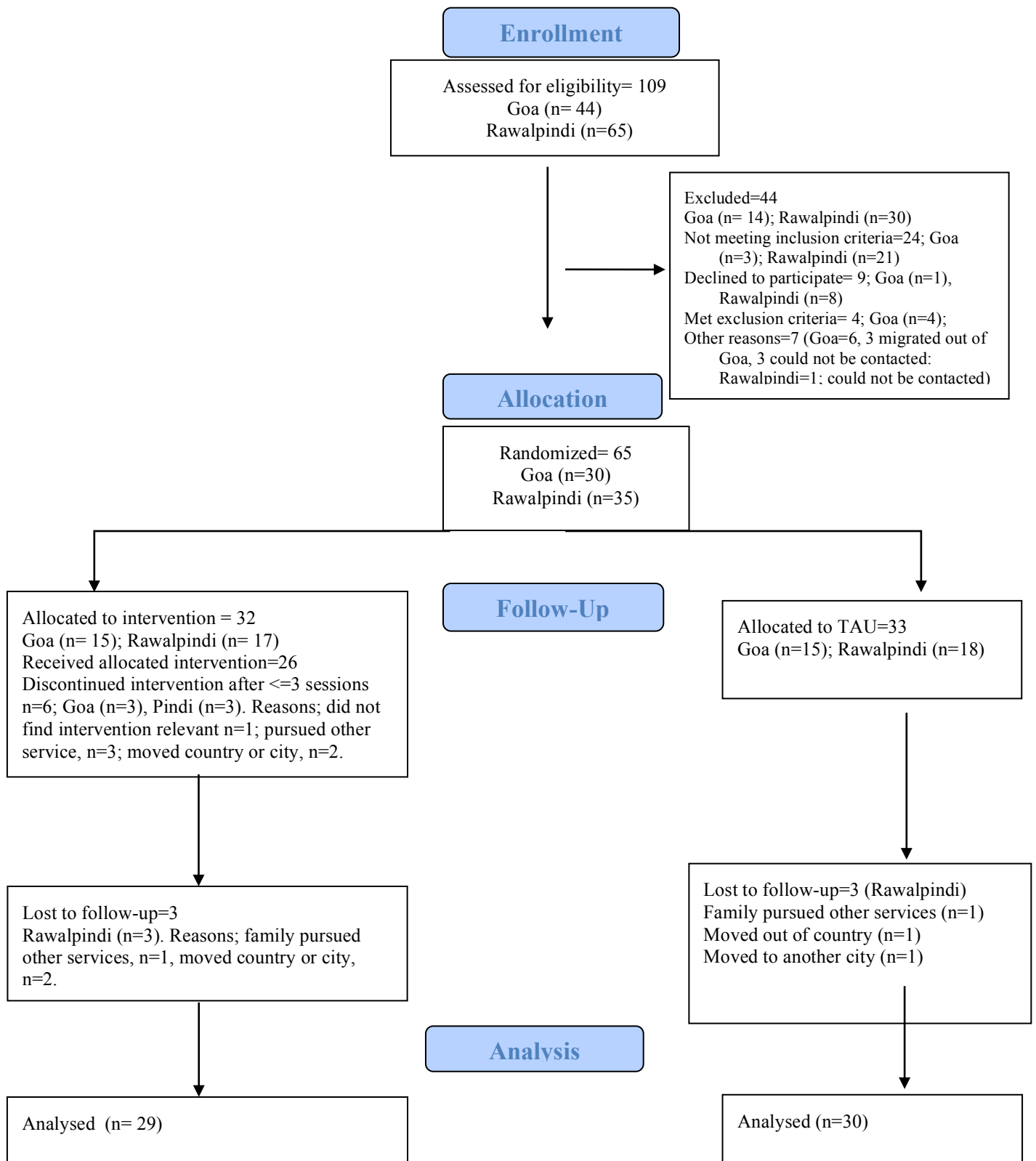


Table 1: Baseline demographics and clinical measures by randomized group.  
N(%) or mean (SD).

Variable	Control (N=33)	Intervention N=32
Site		
Goa	15 (46%)	15 (47%)
Pindi	18 (54%)	17 (53%)
Gender		
Male	27 (82%)	26 (81%)
Female	6 (18%)	6 (19%)
Age		
<6 years	19 (58%)	21 (66%)
≥6 years	14 (42%)	11 (34%)
VABS ABC score		
<65	19 (58%)	19 (59%)
≥65	14 (42%)	13 (41%)
Father's education		
Non-graduate	16 (48%)	22 (69%)
Graduate	16 (48%)	9 (28%)
Missing	1 (3%)	1 (3%)
Age (months): mean (SD)	66.67 (23.60)	63.72 (21.86)
VABS ABC score: mean (SD)		
Goa	57.27 (9.76)	59.60 (10.01)
Pindi	68.39 (9.17)	65.12 (13.54)